Body Mass Index Measurement in Schools*

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ABSTRACT

BACKGROUND: School-based body mass index (BMI) measurement has attracted much attention across the nation from researchers, school officials, legislators, and the media as a potential approach to address obesity among youth.

METHODS: An expert panel, convened by the Centers for Disease Control and Prevention (CDC) in 2005, reviewed and provided expertise on an earlier version of this article. The panel comprised experts in public health, education, school counseling, school medical care, and a parent organization. This article describes the purposes of BMI measurement programs, examines current practices, reviews existing research, summarizes the recommendations of experts, identifies concerns, and provides guidance including a list of safeguards and ideas for future research.

RESULTS: The implementation of school-based BMI measurement for surveillance purposes, that is, to identify the percentage of students in a population who are at risk for weight-related problems, is widely accepted; however, considerable controversy exists over BMI measurement for screening purposes, that is, to assess the weight status of individual students and provide this information to parents with guidance for action. Although some promising results have been reported, more evaluation is needed to determine whether BMI screening programs are a promising practice for addressing obesity.

CONCLUSIONS: Based on the available information, BMI screening meets some but not all of the criteria established by the American Academy of Pediatrics for determining whether screening for specific health conditions should be implemented in schools. Schools that initiate BMI measurement programs should evaluate the effects of the program on BMI results and on weight-related knowledge, attitudes, and behaviors of youth and their families; they also should adhere to safeguards to reduce the risk of harming students, have in place a safe and supportive environment for students of all body sizes, and implement science-based strategies to promote physical activity and healthy eating.

Keywords: growth and development; school health services; child and adolescent health; legislation.

Citation: Nihiser AJ, Lee SM, Wechsler H, McKenna M, Odom E, Reinold C, Thompson D, Grummer-Strawn L. Body mass index measurement in schools. J Sch Health. 2007; 77: 651-671.

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Obesity among children and adolescents has become one of the most critical public health problems in the United States. Childhood obesity is related to numerous physical and mental health problems (eg, type 2 diabetes, cardiovascular disease risk factors, depression, low self-esteem)[1-7] and is associated with adult obesity.[8-10] From 1980 to 2004, the percentage of youth who were obese tripled from 7% in children (6-11 years) and 5% in adolescents (12-19 years) to 19% in children and 17% in adolescents.[11-14] (Note that the classification of obese does not reflect the classification used in the articles cited, but rather the June 2007 recommendations from the Expert Committee on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity.[15])

Schools can play an important role in preventing obesity in children and adolescents. More than 95% of young people are enrolled in schools,[16] and schools have long promoted physical activity and healthy eating. Research has shown that well-designed, well-implemented programs can effectively promote these behaviors,[17-19] and the Centers for Disease Control and Prevention (CDC) has identified 10 key strategies that schools can use to prevent obesity by promoting physical activity and healthy eating.[20]

Measuring the body mass index (BMI) of students in schools is 1 approach to address obesity that is attracting much attention across the nation from researchers, school officials, legislators, and the media.[21-27] Because little research has been conducted on the impact of this approach, it is not included in the CDC's list of recommended strategies. However, some states, cities, and communities have established school-based BMI measurement programs in recent years, and many others are considering the merits of initiating such programs.

BMI measurement programs in schools may be conducted for surveillance and screening purposes. BMI surveillance programs assess the weight status of a specific population (eg, students in an individual school, school district, or state) to identify the percentage of students who are potentially at risk for weight-related health problems. BMI surveillance data are typically anonymous and can be used for many purposes, including identifying population trends and monitoring the outcomes of interventions. BMI screening programs assess the status of individual students to identify those at risk. Similar to other school-based health screenings (eg, vision), BMI screening programs additionally provide parents with information about their child's weight status to help them take appropriate action, if necessary.

In 2005, the Institute of Medicine (IOM) called upon the federal government to develop guidance for BMI measurement programs in schools.[28] The CDC produced this article to inform decision making on implementing such programs. This article describes the purposes of BMI measurement programs, examines current practices, reviews existing research, summarizes the recommendations of experts, identifies concerns about school-based programs, and provides guidance on BMI measurement programs including a list of safeguards and ideas for future research. An expert panel, convened by the CDC in 2005, reviewed and provided expertise on an earlier version of this article. The panel comprised experts in public health, education, school counseling, school medical care, and a parent organization.

BACKGROUND

BMI for Children and Adolescents

What Is Obesity? Obesity is the condition of excess body fat,[29,30] which can lead to such health risks as elevated cholesterol, triglycerides, or insulin levels;[31] high blood pressure;[31] sleep apnea;[32] orthopedic complications;[32] and mental health problems.[3]

What Is BMI? BMI is the ratio of an individual's weight to height squared (kg/m^2), and it is used to estimate a person's risk of weight-related health problems. BMI measures excess body weight for a particular height.[29] It is not a direct measure of body fat but has been shown to correlate with body fat.[33-35] BMI is the most widely used measure of weight-related health risk because direct measures of body fat (eg, skinfold measures, underwater weighing) are more invasive and costly.[29,32-35] A BMI measurement is relatively easy, inexpensive, noninvasive, and quick.[29,32-34] Just as mammography is a screening

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The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the CDC.

The authors thank the following individuals for their review and expertise: Laura Dobbs, president, Georgia Parent Teacher Association; Joyce Epstein, PhD, director, Center on School, Family, and Community Partnerships; Suzanne Bennette Johnson, PhD, professor and chair, Department of Medical Humanities and Social Sciences, Florida State University College of Medicine; Martha Kubik, PhD, assistant professor, School of Nursing, University of Minnesota; Maryann Mason, PhD, executive director, Center for Obesity Management and Prevention, Mary Ann and J. Milburn Smith Child Health Research Program, Children's Memorial Research Center; Mary Pat McCartney, PhD, elementary vice-president, American School Counselor Association; Martha Phillips, PhD, assistant professor, Department of Psychiatry and Epidemiology, University of Arkansas for Medical Science; Shirley Shantz, EdD, ARNP, nursing projects director, National Association of School Nurses; Howard Taras, MD, professor, School of Medicine, University of California San Diego; and Gail Woodward-Lopez, MPH, RD, associate director, Center for Weight and Health, University of California Berkeley.

tool to detect breast cancer, BMI is a screening tool to assess obesity.[32,36] Similarly, mammography results alone do not provide a final diagnosis of breast cancer, and BMI should not be used on its own to provide a diagnosis of obesity.[32] Rather, BMI should be used to identify individuals who need to be examined further by a medical care provider to obtain an informed diagnosis.

How Is Weight Status Determined for a Child or Adolescent Through BMI Measurement? In adults, weight status is determined directly by their BMI (Table 1). However, weight status in children and adolescents is determined by comparing their BMI to other youth of the same sex and age in a reference population. Using data based on sex and age when interpreting a BMI accounts for the growth changes that youth experience throughout childhood and the differences in growth experienced by boys and girls.[37,38]

Once BMI is calculated for a child or adolescent, it is plotted by age on a sex-specific growth chart. (See www.cdc.gov/growthcharts for the CDC's BMI-for-age growth charts for girls and boys, aged 2-20.) Youth BMIs are then converted to percentiles for their sex and age. For example, a 9-year-old girl at the 95th percentile has a higher BMI than 95 out of every 100 9-year-old girls in the reference population.[36,39,40] A youth's weight status is then identified from his or her BMI-for-age percentile (Table 1). Youth are classified as:[15]

- obese if their BMI is at or above the 95th percentile for their age
- overweight if their BMI is at or above the 85th percentile and below the 95th percentile
- normal weight if their BMI is at or above the 5th percentile and below the 85th percentile
- underweight if their BMI is below the 5th percentile.

Table 1. **BMI Categories for Children, Adolescents, and Adults[15]***

BMI Categories for Children and Adolescents	BMI-for-Age and Gender Percentiles for Ages 2-20	BMI Categories for Adults	BMI for Adults
Obese†	≥95th	Obese	≥30
Overweight‡	≥85th and <95th	Overweight	≥25 and <30
Normal	≥5th and <85th	Normal	≥18.5 and <25
Underweight	<5th	Underweight	<18.5

*In accordance with the recommendations of the Expert Committee on the Assessment, Prevention, and Treatment of Childhood Obesity,[15] this document uses the term "obese" to describe youth with a BMI at or above 95th percentile for youth of the same age and gender and the term "overweight" to describe children or adolescents at or above the 85th percentile and below the 95th percentile.

†Previous recommendations define BMI at or above 95th percentile as overweight.[29]

‡Previous recommendations define BMI at or above 85th percentile and BMI < 95th percentile as at risk of overweight.[29]

For example, a 13-year-old boy whose height is 62 inches and weight is 138 pounds has a BMI of 25.2. He is at the 95th percentile on the boys' BMI-for-age growth chart and would be classified as obese and potentially at greater risk of weight-related health problems.[31] This individual would need to be further evaluated by a medical care provider for a final diagnosis of obesity.[29,32,35]

The CDC has developed an online youth BMI calculator to compute BMI and the corresponding BMI-for-age percentile and weight status category (apps.nccd.cdc.gov/dnpabmi/Calculator.aspx). The site provides an interpretation of the result and can display it on the appropriate growth chart.

Different terminology has been used to describe the 2 highest BMI categories for youth. Many of the articles cited in this document categorized children and adolescents with a BMI at or above the 95th percentile for their age as ''overweight'' and those whose BMI is at or above the 85th percentile and below the 95th percentile as ''at risk of overweight.'' However, this document uses terminology recommended by the 2007 report of the Expert Committee on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity, which was convened by the American Medical Association (AMA) and cofunded by the AMA, Department of Health and Human Services' Health Resources and Services Administration, and the CDC.[15] The committee, comprising representatives from 15 national organizations including the AMA, American Academy of Pediatrics (AAP), and the National Association of School Nurses, recommended use of the terms ''obese'' and ''overweight'' for the 2 highest BMI categories.[15]

The weight status of some individuals is incorrectly classified when they are assessed only by their BMI percentile. For example, well-muscled youth might have a BMI above the 95th percentile but are not considered to be at risk for weight-related health problems because they have low levels of body fat.[29] In contrast, youth might have a BMI below the 95th percentile but actually have an elevated risk of weight-related health problems because they have had large annual increases in BMI or present other risk factors, such as 2 obese parents, high blood pressure, or high cholesterol levels.[29]

BMI results in children and adolescents need to be interpreted with caution because height, weight, bone mass, and percent body fat change at different times and rates during the growth spurts that characterize child development, especially puberty.[40] For example, boys who are more advanced in their sexual maturity have less body fat than other boys with a similar BMI, whereas more mature girls have higher body fat levels than other girls.[41,42] BMI measurements collected on an annual basis

and tracked over time reveal important information about the youth's overall growth pattern and are more informative than a single BMI measurement.[43]

Who Needs Follow-Up After BMI Measurement? A young person who has been classified as obese or overweight based on the BMI-for-age percentile will require further examination by a medical care provider to determine whether the individual actually has excess body fat or other health risks related to obesity (eg, diabetes or prediabetes, high blood cholesterol and triglyceride levels, or early pubertal maturation).[29,32,35] The examination might include assessments of the patient's medical history, family history, diet, and physical activity. The provider might also conduct a physical examination (eg, blood pressure and laboratory tests, such as cholesterol screening) and assess patient readiness to change the behaviors that contribute to obesity (eg, $\geq$2 hours television viewing per day).[29,32,43] Medical care providers need to carefully monitor youth with recent, large changes in BMI-for-age percentiles (whether increases or decreases) or whose BMI percentile increases continuously over time, even if these youth are not yet overweight or obese.[29,32,43,44] In addition, youth classified as underweight should also be referred to a medical care provider to determine whether this weight status is due to an underlying physical or mental health condition.[44]

An in-depth examination allows the medical care provider to diagnose underlying causes of underweight or obesity and provides a basis for selecting an appropriate weight management plan.[35,45] The medical care provider will determine if the patient needs a weight maintenance plan (ie, maintain the youth's current weight to prevent excess weight gain) or a healthy and developmentally appropriate weight loss plan.[32,46]

Purposes of Collecting BMI Data

Surveillance. Surveillance refers to the systematic collection, analysis, and interpretation of data from a census or representative sample (ie, a sample that has been scientifically selected to represent a specified population). The data are collected anonymously. The intent of BMI surveillance in schools is to identify the percentages of students in the population who are obese, overweight, normal weight, and underweight; the intention is not to inform parents of their child's weight status.

School-based BMI surveillance data can be used to:

- describe trends in weight status over time among populations and/or subpopulations in a school, school district, state, or nationwide
- create awareness among school and health personnel, community members, and policy makers of the extent of weight problems in the specific populations
- provide an impetus to improve policies, practices, and services to prevent and treat obesity among children and adolescents
- identify demographic or geographic subgroups at greatest risk of obesity to help practitioners and school staff target prevention and treatment programs
- monitor the effects of school-based physical activity and nutrition programs and policies
- monitor progress toward achieving national health objectives (eg, U.S. Healthy People 2010 objectives) or relevant state or local health objectives related to childhood obesity.

Screening. BMI screening programs in schools are designed to assess the weight status of individual students to detect those at risk for weight-related health problems. Screening programs provide parents with personalized health information about their child. Screening results are sent to parents or guardians and typically include the child's BMI-for-age percentile; an explanation of the results; recommended follow-up actions, if any; and tips on healthy eating, physical activity, and healthy weight management.[35,47-49] Results from screening programs also can be used to develop reports on populations similar to those developed by surveillance programs.[50,51]

Goals of BMI screening programs in schools include:

- preventing and reducing obesity in a population
- correcting misperceptions of parents and children about the children's weight
- motivating parents and their children to make healthy and safe lifestyle changes
- motivating parents to take at-risk children to medical care providers for further evaluation and, if needed, guidance and treatment
- increasing awareness of school administrators, teachers, and other school staff of the importance of addressing obesity among students.

Schools sometimes include BMI results with results from other health screening examinations, such as vision or hearing tests, in reports to parents.[52] BMI also can be included as part of a multicomponent fitness assessment report that includes results on tests of fitness components such as aerobic capacity, flexibility, and muscle strength.[53]

Current Practices

The CDC's School Health Policies and Programs Study, conducted in 2006, found that less than half of elementary schools, middle schools, and high schools reported that they measure the height and weight or body mass of their students (Table 2).[54]

Table 2. **Percentage of States, School Districts, and Schools Requiring Collection of Height and Weight or Body Mass Data and Requiring Parent Notification of Results, School Health Policies and Programs Study, 2006[54]**

Jurisdictions	Percent Requiring Collection of Height and Weight or Body Mass Data	Percent Requiring Parent Notification*
States	22.4	72.7
Districts	41.3	71.7
Elementary schools	42.6	83.7†
Middle schools	43.2	88.7†
High schools	40.4	78.0†

*Among states, districts, or schools requiring the collection of these data.
†CDC. Unpublished 2006 School Health Policies and Programs Study data. August 22, 2007.

Nationwide, 22.4% of states required schools or school districts to measure or assess students' height and weight or body mass and 72.7% of those states require parent notification of the results.[54] The study did not determine how frequently students are measured or assessed, whether BMIs are calculated, or the purpose of the data collections.

In recent years, some states have adopted legislation to initiate BMI measurement programs for school-aged youth (Table 3). In 2003, Arkansas received widespread attention when the Arkansas General Assembly established the country's first annual statewide BMI screening and surveillance program (Act 1220) for all students in grades K-12 as part of a larger initiative to improve the health of young people (State of Arkansas, 84th General Assembly, Regular Session, Act 1220 of 2003, HB 1583, 2003). In addition to conducting BMI screening, the Arkansas Department of Education, Department of Health, and the Center for Health Improvement use the BMI data to monitor the prevalence of childhood obesity throughout the state. Pennsylvania began to phase in a BMI screening and surveillance program (28 PA Code §23.7) for all students in grades K-4 in the 2005-2006 school year, with plans to extend data collection to grades K-12 for the 2007-2008 school year (Commonwealth of Pennsylvania, Height and weight measurements, 28 PA Code §23.21. 2004).

In 1995, California passed Assembly Bill 265, which initiated statewide surveillance of student physical fitness levels and body composition. This bill required each school district to administer the Fitnessgram physical performance test during physical education classes to students in grades 5, 7, and 9.[53] Fitnessgram is used to measure aerobic capacity, body composition (BMI for age or skinfold measures), muscular strength, muscular endurance, and flexibility. School districts have the option of sending results to parents, but the state does not collect data on the number of districts that do this. School districts must submit the Fitnessgram results to the California Department of Education at least every 2 years. The results are made public, and reports are available by school, school district, county, and state (www.cde.ca.gov/ta/tg/pf/documents/govreport2005.pdf).[53] California's implementation of Fitnessgram shows how a state can conduct surveillance to assess the health and weight status of school-age youth, integrate the Fitnessgram into curricula (ie, physical education), monitor changes in the physical fitness of students across the state, and use the data to identify needs for quality physical activity programs.

The Illinois Department of Public Health (IDPH) has developed a school-based BMI surveillance system that uses health information collected during students' school physical examinations with their medical care providers. Currently, Illinois requires mandatory physical examinations upon entering the public schools and prior to grades 5 and 9. In 2004, the Illinois General Assembly adopted legislation (Public Act 93-0966) that grants IDPH the right to obtain the health information collected during student physical examinations (Illinois 93rd General Assembly, Public Act 93-0966, SB 2940, 2004). During these examinations, the student's medical care provider records in a health profile their height and weight, and any presentation of asthma, diabetes, tobacco use, or cardiovascular disease. Schools collect each health profile and forward them to the Illinois State Board of Education, which passes them on to the IDPH for calculation of BMI. The IDPH system was launched as a pilot program in the 2006-2007 academic year and will be implemented statewide once the process is refined.

Some states do not require BMI measurement in schools but do provide guidance on this issue for schools or school districts that want to establish such programs. In 2001, the Michigan Department of Education published a consensus paper, *The Role of Michigan Schools in Promoting Healthy Weight,* in cooperation with the Michigan Department of Community Health, the Governor's Council on Physical Fitness, Health and Sports, and the Michigan Fitness Foundation. This document describes safeguards that schools should have established prior to collecting BMI data.[49] In addition, the Michigan Department of Education, in collaboration with the Michigan Department of Community Health, produced a training manual and the *Healthy Kids Healthy Weight* resource, which consists of educational handouts for families about healthy eating and physical activity.[60]

Research on BMI Measurement Programs

Studies have not yet assessed the utility of school-based BMI measurement programs in preventing

Table 3. **State-Legislated BMI Measurement Programs in Schools***

State	Legislation	Program Purpose	Program Description
Arkansas	Act 201 (2007) (amendment to Act 1220)	Screening and surveillance	• Mandates annual BMI screening for all students in kindergarten and even grades; students in 12th grade are exempt • Tracks childhood obesity across the state to determine baseline prevalence of weight problems; data will be used to measure the impact of concurrent policy changes promoting physical activity and healthy eating • School nurses, physical education teachers, and coaches conduct screenings • BMI-for-age percentile results are reported to parents and guardians • The Arkansas Department of Education, Department of Health, and the Center for Health Improvement created a centralized database for data analysis
California	Education Code Section 60800 (amended in 2003)	Surveillance	• Student physical fitness is assessed through the Fitnessgram test, which includes measurement of body composition (determined either by BMI or by skinfold measures) • The tests are administered to all students in grades 5, 7, and 9 • Physical education teachers conduct the testing • Physical fitness testing results are presented in a school accountability report card. Each local education agency submits its physical fitness testing results to the State Department of Education. The data are aggregated and reported to the Governor and Legislature every year
Florida	Statute 381.0065(8) (1973)	Surveillance with optional screening programs for school districts	• Local education agencies or local health departments screen for height and weight, vision, hearing, and scoliosis to assess growth and development • All students in kindergarten and grades 1, 3, and 6 are screened • School screening teams include nurses, paraprofessionals, and some teachers • Results from the school health programs are aggregated and sent to the local health department. The data are entered in the state data system and forwarded to the School Health Services Program in the Florida Department of Health. Local school districts decide whether to send results to parents
Illinois	Public Act 93-0966 (2004)	Surveillance	• Students are required to visit their medical care provider for a health examination. The provider creates a student health profile reporting the student's height, weight, asthma, diabetes, tobacco use, and cardiovascular disease status (eg, heart problems or shortness of breath, high blood pressure or heart murmurs, and dizziness or chest pain with exercise) • The IDPH is in the process of developing a statewide surveillance program with the student health profiles. A pilot surveillance program began in 2006 and will be implemented statewide once the procedure is refined • Health examinations are required for nursery, kindergarten, and grades 1, 5, and 9 or upon entrance to the school system • The student's medical care provider measures the student's height and weight • Schools collect the results from the health examinations and forward them to the Illinois State Board of Education. Since 2004, the IDPH has had the right to access these data for statewide surveillance
Louisiana	Act 734 (2004)	Surveillance	• A representative sample of Louisiana public schools is participating in a 3-year nutrition and physical activity intervention to address obesity • The Fitnessgram is administered to students in the participating schools who are enrolled in physical education in grades 3, 5, 7, 9, and 11 • Physical education teachers measure students' height and weight • Each school in the program produces an annual report on the program objectives for the Department of Education. When the pilot program is complete, the Department of Education will report the findings to the Louisiana Senate and House committees

Table 3. **Continued**

State	Legislation	Program Purpose	Program Description
New York	Education Code Article 19 Section 903, 904 (amended in 2007)	Screening and surveillance	• Students are required to furnish a health certificate at school entry or kindergarten and in grades 2, 4, 7, and 10. The health certificate describes the condition of the student and specifies whether the student is in a fit condition of health to permit her/his attendance at school. The health certificate shall include BMI and weight status category • The student's medical care provider measures the student's height and weight, calculates BMI, and specifies corresponding weight status category • School nurses collect the health certificates. A representative sample of public schools will be required to aggregate weight status categorical data from the health certificates and submit data to the New York State Health Department
Pennsylvania	28 PA Code §23.7 (2004)	Screening and surveillance	• Students have their height and weight measured annually as part of the required school health services provided by the schools • Students in grades K-8 were assessed in the 2006-2007 academic year; students in all grades, K-12, will participate beginning in the 2007-2008 academic year • School nurses, health education teachers, or physical education teachers measure students' height and weight • Schools are required to send letters to parents or guardians with the child's BMI-for-age percentile and an explanation of the results • Each local education agency, charter school, and comprehensive vocational-technical school must report aggregate student data each year to the Pennsylvania Department of Health
Tennessee	TN Code §49-1-1002 (2000)	Screening and surveillance	• Students are screened for height, weight, vision, hearing, blood pressure, dental problems, and scoliosis in 10 rural school districts participating in a coordinated school health pilot program • Students are screened in kindergarten and grades 2, 4, 6, 8, and 10 • School nurses measure students' height and weight and calculate their BMI • Parents and guardians are notified of their child's BMI results • Data are reported to the Department of Education, general assembly, governor's office, and East Tennessee State University as a part of an extensive outcome evaluation of program
Tennessee	Public Chapter 194 (2005)	Optional screening and surveillance	• Local education agencies are authorized to identify public school children who are at risk of obesity • The Department of Health and Department of Education are required to provide training to help communities develop BMI screening programs. The legislation established a system for local education agencies to report the BMI results to the Department of Health for analysis. Aggregate data are distributed to the governor's office and the speakers of the House and Senate every year • Students in all grades may be measured if the school or school district makes the decision to implement a BMI measurement program • School staff and volunteers measure student height and weight and calculate their BMI
Vermont	Act 161 (2004)	Optional surveillance	• Schools are authorized to measure student height and weight data • Students in grades K-6 may be measured if the school or school district makes the decision to implement a BMI measurement program • All height and weight data collected are shared with the Department of Health
West Virginia	Act 121 (2005) (amended 2006)	Surveillance	• BMI data are collected from a scientifically drawn sample of students and are used as an indicator to measure progress toward promoting healthy lifestyles in West Virginia • Students are measured in kindergarten, grades 2 and 5 with plans to phase in grades 7, 9, and 11 • School nurses and West Virginia University medical students measure height and weight • Data are reported to the West Virginia Department of Education through the West Virginia Education Information System. Aggregate data are reported to the governor, the Board of Education, Healthy Lifestyles Coalition, and Legislative Oversight Commission on Health and Human Resource Accountability

*The following sources were reviewed to identify state legislation on BMI measurement programs in schools: legislative databases on state general assembly Web sites, the National Association of State Boards of Education state-level policy database,[55] The National Conference of State Legislatures,[56] Netscan's Health Policy Tracking Service,[57] and other relevant sources.[58,59] In addition, staff in the education or health department of each state that had passed legislation on school-based BMI measurement programs was contacted by telephone and asked to provide an accurate description of the program. This table does not include a description of BMI measurement programs mandated by legislation that have not yet been implemented.

increases in obesity among youth. However, a small but growing body of research has addressed some of the issues related to these programs.

Perceptions of Weight Status. Several studies have found that parents and children commonly misclassify the children's weight status.[51,61-66] One study of 742 mothers of adolescents found that 35% underestimated their child's weight status and 5% overestimated it; 86% of mothers whose child had a BMI at or above the 95th percentile did not identify their child as overweight.[62] Brener et al assessed the association between weight perception and measured BMI among a sample of 2032 adolescent students in high school. The authors found that 26.2% of obese students perceived themselves as underweight and another 20.0% perceived themselves as ''about the right weight''; only 6.3% of normal-weight students perceived themselves as overweight.[63]

Parental Perceptions of BMI Screening in Schools. A number of studies have found that most parents support and respond positively to BMI screening programs in their children's schools.[51,67-70] Investigators who analyzed focus group discussions with parents of elementary school children in Minnesota concluded that parents are receptive to the idea of BMI screening in schools, provided it is done with care and parents are involved in developing the program.[69] The parents identified potentially positive outcomes that could result from screening programs, including an increased ability to address weight-related topics with their children and advocate for school-level improvements. They also believed that informing decision makers, such as school administrators and state legislators, of the screening results could result in increased support for school health initiatives. The researchers found that parents would support programs if they received advanced notice about BMI measurement programs, have the opportunity to decline permission for their children to participate, receive assurance that the measurements would be collected in a private and respectful manner that minimizes weight-related teasing, and receive the results in a letter mailed to all parents that used a neutral tone and did not assign blame. The parents also supported aggregating the results for use by the school, community, and state.[69]

A pilot BMI screening program was developed based on the findings of these focus groups; 4 elementary schools were recruited to examine parental reaction to BMI measurement in schools.[68] All 4 schools conducted height and weight measurements; however, the 2 intervention schools had BMI results mailed to parents, whereas the remaining 2 schools did not mail results home. A follow-up survey found that 78% of parents in all 4 schools believed it was important for schools to assess and send home BMI results as part of annual student health screening reports. Parents of older students and girls were less likely than parents of younger children and boys to want the annual BMI screening information.[68]

Researchers in Ohio surveyed 117 parents of elementary and middle school–aged children regarding the schools' role in addressing childhood obesity.[70] In addition to parents reporting that they found BMI to be useful in providing information about their child's weight, the majority (80%) agreed that schools are an appropriate site for weight screening.[70]

However, a different study conducted in Ohio found that while parents supported schools in playing a role in reducing obesity, many parents were least likely to support the approach of collecting height and weight measurements or informing parents of their child's height and weight.[71] Investigators asked 344 parents of elementary school students in Ohio to rate the importance of 37 different actions schools could take. When the parents were asked the importance of the school measuring each child's height and weight, 15.5% rated this action as very important and 27.3% rated it as not important. When the parents were asked the importance of the school informing parents of their child's height and weight, 19.5% rated this action as very important and 30.3% rated it as not important. Parents were least likely to support these 2 actions and were substantially more supportive of using school resources on the remaining 35 actions to promote healthy eating and physical activity and improve the school health environment.[71]

Parental Responses to BMI Screenings. The Know Your Body school health promotion program, which included a cardiovascular disease risk factor screening component, surveyed parents of children from 4 Michigan elementary schools on their response to receiving a letter indicating their child's screening results, including weight status, with a corresponding explanation on interpreting the results.[72] The letter listed recommended actions for parents if the results were abnormal (eg, contact a physician). Eighty-six percent of parents reported that they discussed the results with their children, but only 12% of the parents reported that they discussed the results with their family physician. The authors concluded that future projects should include strategies for encouraging parents to share their results with physicians or consider providing the results directly to physicians.[72]

Chomitz et al evaluated the effects of a school-based health ''report card'' in an ethnically diverse population at 4 elementary schools in an urban area.[67] Nearly, half (43%) of parents whose child had a BMI $\geq$ 85th percentile reported that their child had a healthy weight. The investigators assessed the impact of the report card on family awareness and concern about their child's weight, plans for weight control, and preventive behaviors.

Families were stratified into 3 groups: (a) 1 group of families received a personalized report of their children's height, weight, and weight status; fitness test results; interpretive information; and tips for healthy living; (b) another group only received the tips for healthy living; and (c) a control group did not receive any information.[67]

Parents in both of the groups that received the tips for healthy living reported that they would like to receive information related to their child's weight on an annual basis;[67] they were significantly more likely to identify their child's weight status correctly (44% of the parents who received the report card and tips for healthy living and 41% of the parents who only received the tips for healthy living) compared with parents in the control group (23%). Neither group of parents who received the tips for healthy living reported increasing their engagement in the behaviors highlighted on the fact sheet (eg, increase physical activity). The group who received their child's BMI results were more likely than the other 2 groups to report that they had initiated or intended to initiate clinical services, dieting, or physical activity as part of a weight-control plan for their children. Seven of the 19 families planning to initiate dieting reported that they planned to do so without seeking medical counsel.[67] The authors concluded that health report cards may be an informative and motivational tool for parents, but more research is needed to test the impact on youth self-esteem and plans to initiate weight-control activities.[67]

BMI Surveillance Programs. Some research has been conducted on implementing state-level BMI surveillance systems in schools to determine the prevalence of obesity among school-aged youth.[73-75] The Texas Department of Public Health implemented the School Physical Activity and Nutrition monitoring system in Texas elementary, middle, and high schools;[73] the University of Georgia initiated the Georgia Childhood Overweight Prevalence Survey in Georgia elementary, middle, and high schools;[75] and Mississippi researchers conducted the Child and Youth Prevalence of Overweight Survey in Mississippi elementary and middle schools.[74] A statistical sampling procedure was used in all 3 surveys to randomly select a sample of schools and students, so that the data were representative of school-aged youth in each state.[73-75]

All 3 surveillance systems obtained parental consent and measured student height and weight in the schools.[73-75] The student response rates ranged from 60.5% in Georgia (3114 students) to 96% in Mississippi (1658 students).[74,75] In Texas, 6630 students were measured with participation lower in the higher grades: 39.0% of students participated in 11th grade versus 80.1% in 4th grade.[73] Both the Georgia and the Texas studies found that their states had substantially higher prevalence of childhood obesity compared with the rest of the country.[73,75] All 3 studies identified non-white race groups as having higher prevalence of obesity.[73-75]

Representative surveys of height and weight also have been conducted among students in large cities, such as New York City[76] and Los Angeles.[77] The Los Angeles survey used BMI data collected from the Fitnessgram physical performance tests of 281,630 students enrolled in grades 5, 7, and 9.[77] Researchers were able to estimate the prevalence of obesity among all students and across 6 racial/ethnic groups. They then linked their data with school-level indicators on socioeconomic status (SES), available from the U.S. Census and the National School Lunch Program to analyze the association between SES and obesity.[77]

Evaluation of the Arkansas School-Based BMI Screening and Surveillance Program. Arkansas's Act 1220, passed in 2003, addresses childhood obesity by requiring public schools to restrict vending machines in elementary schools, disclose information on their food and beverage contracts, and annually screen all students for BMI with parents notified of results through a health report mailed to the home (State of Arkansas, 84th General Assembly, Regular Session, Act 1220 of 2003, HB 1583, 2003).[78] The Act also created school district Nutrition and Physical Activity Advisory Committees and a state Child Health Advisory Committee (State of Arkansas, 84th General Assembly, Regular Session, Act 1220 of 2003, HB 1583, 2003).[78]

The Arkansas Departments of Health and Education established protocols for standardizing height and weight measurements, trained nurses and other school personnel in measuring height and weight, and created a system to ensure confidentiality of the students' BMI results.[78] The percentage of schools participating in the statewide BMI assessments increased from 94.3% in 2003-2004 to 98.6% in 2005-2006.[50] Approximately 5-6% of students could not be assessed because they or their parents refused to participate in the screening program.[50]

An evaluation of the impact of Act 1220 in 2004-2005 and 2005-2006 included key informant interviews, surveys of principals and superintendents, telephone interviews with adolescents, and telephone interviews of parents.[51,78,79] The percentage of parents who classified their child accurately as overweight or at risk of overweight increased from 40% at baseline to 53% after the first year of screening.[51] Ninety-one percent of adolescent students reported that they were comfortable with the confidentiality of the screening process.[51]

Approximately half (52%) of Arkansas principals reported that they had no parents contact them about the BMI measurements. Of the principals who

reported hearing from parents, 76% heard from fewer than 5 parents on this issue. The evaluation also reported that ''many school personnel, particularly school nurses, continue to feel overwhelmed by having to add Act 1220's mandates to all of their other tasks.''[51]

Early results from the Arkansas evaluations indicate that progress is being made in the state's efforts to combat childhood obesity. Although the prevalence of obesity among children has been rising continuously in the nation as a whole, the percentage of Arkansas students classified as obese was 20.9% in 2003-2004, 20.8% in 2004-2005, and 20.4% in 2005-2006.[50] It is still too early to determine whether this is the beginning of a trend toward stabilization and eventual decline in the prevalence of obesity; because Arkansas implemented several new programs and activities to decrease childhood obesity, it will be difficult to determine how much of any apparent progress made can be attributed specifically to the BMI screening program.

In early 2007, Arkansas legislators amended Act 1220 to reduce the number of times that students are measured for BMI from annually to every other year, starting in kindergarten and ending in 10th grade (State of Arkansas, 86th General Assembly, Regular Session, Act 201 of 2007, HB 1173, 2007). Legislators who supported the amendment stated that they believed the BMI screening program had unintended, negative consequences on self-esteem, and stigmatized students.[26,80]

Recommendations From Expert Organizations on BMI Measurement for Children and Adolescents

The use of BMI measurement for surveillance purposes, regardless of setting, has been endorsed by the American Public Health Association (APHA) and IOM.[28,81] APHA supports the establishment of surveillance programs that allow states to monitor geographic distribution, secular trends, and progress in reducing the prevalence of childhood obesity.[81] The IOM supports surveillance efforts to identify populations most at risk of childhood obesity as well as the social, environmental, and behavioral factors contributing to obesity.[28]

The AAP recommends that BMI be calculated and plotted annually on all children and adolescents as part of normal health supervision within the child's medical home. In addition, AAP recommends analyzing changes in BMI to identify any rate of excessive weight gain relative to changes in height.[43,82] However, the US Preventive Services Task Force (USPSTF) found no direct evidence that routine BMI screening for children and adolescents in the clinical setting improves behavioral or physiologic measures or health outcomes in large measure because of the paucity of evidence on the effectiveness of weight management interventions for this population. The USPSTF concluded that ''... the evidence is insufficient to recommend for or against routine screening for overweight in children and adolescents as a means to prevent adverse health outcomes.''[83] At the same time, it found insufficient evidence to ascertain potential harms resulting from BMI screening, such as poor self-concept or disordered eating.[83]

The IOM recommends that schools measure annually each student's weight and height and make information about their BMI percentiles available to the parents and, when age appropriate, to the student.[28] In this way, according to the IOM, parents of students who do not receive annual health examinations as well as those without health insurance can learn their child's weight status.[28] Other expert organizations encourage schools to exercise caution before adopting BMI measurement programs. The Health, Mental Health, and Safety Guidelines for Schools, produced by the AAP and the National Association of School Nurses in conjunction with 300 other organizations, recommend that schools evaluate a number of factors before implementing a school-based BMI measurement program, including cost, the availability of remediation and follow-up for all students with positive screening results, and the relative efficiency of using schools as the screening site.[84] The Society for Nutrition Education (SNE) calls for limiting screening for weight, height, and body fat in schools to situations of identified need and purpose, such as for baseline and outcome evaluations of programs to prevent or treat obesity; SNE recommends that when BMI is measured, it should not be used as a single measurement for determining health status and that programs addressing obesity should focus on health rather than weight.[85]

Challenges to BMI Measurement Programs in Schools

Some authors, parents, and legislators have expressed concern that measuring height and weight in schools, particularly for screening purposes, might have unintended, negative consequences for youth.[21-23,25-27,85] Concerns and challenges raised about BMI measurement programs are described below.

BMI measurement programs, especially screening programs, might stigmatize students and lead to harmful behaviors.[23,25,27,85] Obese children are at increased risk of being teased, bullied, or socially isolated and having low self-esteem or depression.[4-6,28,86-88] By placing heightened attention on weight, BMI measurement programs might intensify:

- the stigmatization already experienced by many obese youth, putting them at even greater risk of

being discriminated against or bullied and having psychological problems[22,23,26,69]
- dissatisfaction with body image[23,89]
- pressure to engage in harmful weight loss practices that could lead to eating disorders.[22,23,27,90]

In 2005, the Youth Risk Behavior Survey (YRBS) found that approximately 1 in 6 US high school students engaged in unsafe practices to lose or maintain weight, such as fasting, taking diet pills, or laxatives, or inducing vomiting.[91] Weight concerns are a major risk factor for the onset of eating disorders.[90] Anecdotal reports indicate that some normal-weight students do not understand their school BMI reports, and this misunderstanding increased their anxiety about their weight.[25] However, by providing students with an accurate assessment of their BMI, a screening program has the potential to correct misperceptions of weight concern in normal-weight students and inform them that they are not obese; this is important because these types of misperceptions of weight status appear to be significant risk factors for suicidal behavior.[92]

Another concern is that some parents might respond inappropriately to BMI reports by, for example, placing their child on a restrictive and potentially harmful diet without seeking medical advice.[22,23,27,67] Restrictive diets that are not supervised by medical care professionals can stunt growth, lead to disordered eating patterns,[93,94] and foster cycles of weight gain and loss that are counterproductive to weight control.[94-96]

Research is beginning to emerge on examining potential links between school-based BMI screening programs and increases in stigmatization or unsafe weight-control practices. Chomitz et al found that some parents who received BMI reports from their children's schools planned to put their children on diets without medical guidance despite strong recommendations against such actions in the materials accompanying the BMI reports.[67] However, surveys of Arkansas students showed that parents have not put their children on diets with greater frequency than they did before the implementation of the BMI screening program.[79] Surveys of Arkansas students found that they have not gone on diets at a greater rate than before the implementation of the BMI screening program and they did not report being teased more because of their weight.[79] Seven percent of the Arkansas students surveyed reported feeling embarrassed by having their BMI measured.[51]

The IOM noted that some concerns about unintended consequences have been addressed successfully by schools that measure height and weight as part of routine school nursing practice and by school-based interventions that have collected height and weight data.[28] In addition, many school-based intervention studies have conducted height and weight measurements in schools and did not report any negative consequences.[28] However, the IOM stresses the importance of collecting and communicating information in a sensitive manner.[28]

BMI screening programs may be ineffective and, therefore, waste resources that could be invested in more effective obesity prevention activities.[97] Measuring height and weight in school settings requires resources.[97] Costs can include (a) hiring and training staff; (b) allowing staff time to plan data collection, conduct measurements, and analyze and disseminate results; (c) purchasing standardized equipment that measures height and weight accurately; (d) obtaining computer equipment and software for recording and analyzing students' BMI; and (e) translating, printing, and mailing introductory letters, permission slips, and results to parents.

BMI measurement programs require durable equipment including a scale to measure weight and a stadiometer to measure height. One BMI station (eg, a scale and stadiometer) has been reported to cost up to $500[98] and must be regularly maintained and calibrated. In addition, computers and software programs may need to be purchased to efficiently calculate and store BMI data. Screening programs, which typically measure all students, are generally more expensive than surveillance programs, which typically measure only a sample of students. Screening programs also face additional costs for follow-up activities (eg, organizing a medical care referral system) and the associated costs for letters and educational materials mailed home to parents.

The resources spent on a BMI screening program will be wasted if the program is ineffective. A complaint raised against school-based BMI screening programs is that weight is more visible than other health conditions, so parents know whether their children are obese or not.[25] However, studies have documented that a substantial proportion of obese children and their parents do not perceive the child to be obese.[61-66] If this misperception contributes to parental complacency and failure to support improvements in the child's diet and physical activity behaviors, then correcting any misperception through BMI screening programs could be an important contribution to public health. However, the effects of BMI screening on parental attitudes and actions have not been sufficiently evaluated.

Concerns have been raised that parents might fail to follow-up with a medical care provider after learning that their child is classified as obese or overweight.[22-24,27,67] The Arkansas evaluation found that parents did not consult school nurses about their child's BMI.[51] While 57% of local family practitioners and pediatricians surveyed reported that

at least 1 parent had brought in a child's BMI letter for discussion, most did not report hearing from a substantial number of parents wanting to discuss their child's weight status.[51] In the screening component of the Know Your Body program, the authors expressed concern that only 16% of parents whose children were classified as obese discussed the results with their family physician.[72]

Parents may be motivated to take action after receiving their child's BMI results, but their community might lack the appropriate medical care service, access to healthy and affordable food choices, safe locations for physical activity, or other resources needed to address the problem.[25,28,82,97] BMI screening programs cannot help young people achieve a healthy weight if adequate school or community services do not exist for appropriate follow-up.

Youth identified as obese or overweight might require professional assistance to prevent further weight gain or to lose weight.[46] However, effective programs might be difficult to find and expensive;[23,82] evaluations of pediatric weight loss programs conducted by well-trained health professionals have documented only mixed success.[35] Furthermore, many physicians, school nurses, and other health practitioners lack the necessary training to provide follow-up and counseling to youth and their parents on weight management, nutrition, and physical activity.[99,100]

BMI screening programs might distract attention from other school-based obesity prevention activities. BMI screening programs might require resources that would otherwise be used to promote physical activity and healthy eating, such as school-level or school district–level policy changes, improvements in the school physical activity and nutrition environment (eg, integrating physical activity into classroom instruction or establishing standards for foods and beverages sold on campus), and changes to the physical education and nutrition education curricula.[97] Concerns have been raised that BMI screening programs shift the focus from promoting positive strategies for a healthy lifestyle toward a more negative and ultimately counterproductive focus on weight and body image, such as dieting and weight loss.[85,97] These programs could potentially distract schools from collecting data on changes in physical activity and dietary behaviors, which might be more realistic and meaningful objectives for school health programs than changes in BMI.[85]

Several schools have faced public opposition to BMI screening programs, especially when these programs were initially introduced.[24,25,101] Some citizens believe that it is not the school's responsibility to conduct such programs.[25] Whether these beliefs are well founded or not, this type of opposition could potentially diminish support for other school-based prevention efforts. However, some school-based BMI screening programs that received substantial early criticism by the media and parents have documented a decrease in the negative responses after the program had been established and parental concerns were addressed.[24,51,52,101,102]

GUIDANCE ON MEASURING BMI IN SCHOOLS

Surveillance Programs

The collection of BMI data for surveillance purposes is less controversial than BMI screening because surveillance does not involve the communication of sensitive information to parents, does not require individualized follow-up care for students identified to be at risk, and is therefore not likely to generate negative public response or detract from existing prevention programs.

Ideally, BMI should be derived from actual measurements of height and weight. However, measuring the height and weight of large numbers of students may not be feasible and can be costly and logistically challenging. An alternative approach is to use self-reported height and weight for surveillance among adolescents. The CDC's YRBS, a national, state, and school district survey of health-risk behaviors among high school students, has reported BMI data every other year since 1999 using self-reported height and weight.[103,104] A YRBS validation study found that self-reported height and weight are reliable (ie, the same numbers are consistently reported) and that BMIs derived from self-reports are highly correlated with those derived from actual measurements.[105]

However, using self-reported data have limitations that should be kept in mind. High school students tend to overestimate their height and underestimate their weight: as a result, BMI tends to be lower and the prevalence of obesity tends to be underestimated.[105] Similar results have been found in adults.[106] Furthermore, youth who are obese underestimate their weight more than those who are normal weight.[107] This self-report bias may further distort results as more individuals become obese, resulting in inaccurate prevalence and trend data.[107]

Screening Programs

Policy makers need to consider many factors in deciding whether to implement school-based BMI screening programs. The AAP has developed criteria to help guide decisions on whether schools should implement a screening program for any pediatric health problem.[108] To receive AAP support, all of these criteria must be met (Table 4).

BMI screening programs clearly meet some of the criteria: obesity is an important public health problem;[13] the prevalence of obesity in the general population of children and adolescents is high;[14]

Table 4. **AAP Criteria for a Successful Screening Program in Schools**[108]

Criteria	Criteria for a Successful Screening Program in Schools
Disease	Undetected cases must be common or new cases must occur frequently and the disease must be associated with adverse consequences
Treatment	Effective treatment must be available and early intervention must be beneficial
Screening test	The test should be sensitive, specific, and reliable
Screener	The screener must be well trained
Target population	Screening should focus on groups with high prevalence of the condition/disease in question or in which early intervention will be most beneficial
Referral and treatment	Those with a positive screening test must receive a more definitive evaluation and, if indicated, appropriate treatment
Cost/benefit ratio	The benefit should outweigh the expenses (ie, costs of conducting the screening and any physical or psychosocial affects on the individual being screened)
Site	The site should be appropriate for conducting the screening and communicating the results
Program maintenance	The program should be reviewed for its value and effectiveness

a screening test is available, that is, sensitive,[34] specific,[34] and reliable;[33] staff training is available on how to properly conduct screenings;[45,49,109] and schools are an appropriate site because they can reach virtually all youth including those without medical coverage.

However, school-based BMI screening programs do not meet other AAP criteria for screening programs. Specifically, effective and available treatments for obesity are not available,[23,35,110] no standardized referral system exists,[28] and the effectiveness and cost-effectiveness of BMI screening programs over time have not been documented. The AAP specifies that schools and school districts should not implement screening if resources for follow-up do not exist.[108] Furthermore, research is needed to better understand any possible psychosocial effects on the individuals being screened, such as increased stigmatization and unsafe weight-control practices.

BMI Measurement Program Safeguards

Before launching a BMI measurement program for surveillance or screening, decision makers need to consider whether the anticipated benefits outweigh the expected costs. To minimize potential harm and maximize potential benefits, schools should not launch a BMI measurement program unless they have established a safe and supportive environment for students of all body sizes; are implementing a comprehensive set of strategies to prevent and reduce obesity; and have put in place a series of safeguards that address the primary concerns raised about such programs.

Following are some key characteristics of a safe and supportive environment for students of all body sizes:[49]

- there is zero tolerance for weight discrimination, disrespectful behavior, and bullying
- curricula foster acceptance of healthy weight by effectively countering social pressures for excessive thinness
- teachers, school counselors, school nurses, coaches, and other school staff receive the professional development and resources they need to provide useful guidance to students with weight-related concerns. Staff should be prepared to promote positive body image and body satisfaction; help students overcome barriers to healthy eating and physical activity; and help students enhance their ability to find social support, cope with teasing, set goals, and make decisions.

If schools raise student and family awareness about obesity through a BMI measurement program, they need to have in place an environment that helps students make healthy dietary and physical activity choices both in and away from the school setting. The CDC has identified a comprehensive set of 10 strategies that schools can implement to prevent obesity by promoting physical activity and healthy eating (www.cdc.gov/healthyyouth/keystrategies).[20,111] Many resources are available to help schools implement these strategies, including the following:

- the *School Health Index: A Self-Assessment and Planning Guide* helps schools assess and improve their health and safety policies and practices (www.cdc.gov/HealthyYouth/SHI)[112]
- the US Department of Agriculture has dietary guidelines for the national school meals program[113]
- the IOM has published nutrition guidelines for foods and beverages offered outside of school meals[114]
- schools can assess their physical education curriculum and align it with national standards by using the CDC's *Physical Education Curriculum Analysis Tool* (www.cdc.gov/healthyyouth/pecat).[115]

A number of programs have integrated BMI measurement into more comprehensive approaches to addressing obesity. For example:

- Arkansas Act 1220 mandated the creation of new programs to promote physical activity and healthy eating.[78]

- The results from California's Fitnessgram physical performance test influenced the California Department of Education to develop statewide grade-specific physical education content standards for student knowledge and ability.[116]
- In Pennsylvania, the East Penn School District raised awareness of the importance of student health after implementing a BMI screening program.[24] This led to changes in school policies and practices, including replacement of the sweetened drinks with 1% milk and 100% juice in vending machines, elimination of candy and high fat snack sales in vending machines, establishment of walking clubs, and increasing the length of lunch periods.

Following is a list of safeguards that need to be put in place to address the primary concerns that have been raised about school-based BMI measurement programs.[21,49] These safeguards are needed to ensure respect for student privacy and confidentiality, protect students from potential harm, and increase the likelihood that the program will have a positive impact on promoting a healthy weight.

1. Introduce the program to parents, guardians, students, and school staff; ensure that there is an appropriate process in place for obtaining parental consent for measuring students' height and weight.

To help minimize negative response from the public, programs need to involve parents or guardians early in the planning stages.[24,117] Before the program begins, all parents should receive a clear description of the program to minimize confusion and anxiety. Communications with parents should focus on the health implications of obesity, overweight, and underweight and make it clear that the school will be measuring weight out of concern for a student's health, not their appearance or a desire to criticize parenting practices.[43,85] Schools should assure parents and students that the screening results will remain confidential. In addition, students and school staff should be informed of the purposes and logistics of height and weight measurement, as well as the school's policy on sharing results.

Parents must be given the option of declining permission to measure their child's BMI.[24,117] Some programs use passive parental consent; that is, all students have their BMI measured unless parents send a written refusal. For example, at the beginning of each school year, Florida school districts inform parents about the school health program and the screenings that are conducted in each grade.[52] Parents can choose not to have their child screened; otherwise, all students are measured in grades K, 1, 3, and 6. Other jurisdictions, such as Michigan, recommend active consent from both parents and students; only students who signed the consent form and whose parents have submitted a signed consent form are screened.[49]

2. Ensure that staff members who measure height and weight have the appropriate expertise and training to obtain accurate and reliable results and minimize the potential for stigmatization.

Accurate measurements are those that correspond to the youth's actual height and weight, whereas reliable measurements are those that produce consistent results when they are repeated.[109] Measurements are more likely to be accurate and reliable when they are conducted by trained professionals, such as school nurses.[23,118] Unfortunately, many schools do not have full-time nurses on campus,[54] and many school nurses feel that they cannot add another responsibility to their workload.[51] Staff members involved in the program need the appropriate technical training from people who are experienced in conducting height and weight measurements and calculating and interpreting BMI results.[119] Conducting repetitive tasks, such as measuring height and weight, can be tedious and may lead an individual to become careless and fail to consistently follow measurement protocols. Quality control checks can be implemented through random visits at measurement sites to oversee the performance of the staff measuring students' height and weight.

Staff members need to ensure that each student takes off his or her shoes and jacket or other heavy clothing items and removes all items from his or her pockets before being weighed.[120] Similarly, staff members must make sure that hair styles do not interfere with an accurate measurement of height.[120] Each measurement should be taken twice and the youth should be repositioned prior to each measurement.[109] If the 2 measurements do not agree within one fourth of a pound for weight or one fourth of an inch for height, then 2 additional measures should be taken until there is an agreement.[109,119] Height errors, in particular, reduce the validity of BMI substantially.[109]

Staff also need appropriate training to measure height and weight in a sensitive and caring manner. This training should address procedures to maintain student privacy during measurement,[49] increase awareness of groups at increased risk of stigmatization (ie, larger students, shorter boys, and taller girls), provide information about body size acceptance and the dangers of unhealthy weight-control practices, and help staff identify indications of student problems related to weight or body image (eg, eating disorders). Staff should be prepared to respond to questions or comments by students. For example, if a student makes a negative comment about his or her own weight, staff members need to be able to respond with supportive statements such as ''Kids' bodies come in lots of different sizes and shapes. If other kids are teasing you about your body, let's talk and see what we can do about

it.''[21] Staff members also need to know how to respond to questions about what the school will do with the measurement results and referrals.

Resources that can assist with training on height and weight measurement include:

- The federal Health Resources and Services Administration's Maternal and Child Health Bureau Web site:[109] depts.washington.edu/growth.
- The CDC's Division of Nutrition, Physical Activity, and Obesity Growth Chart Training Modules:[45] www.cdc.gov/nccdphp/dnpa/growthcharts/training/modules.
- The Center for Weight and Health's Guidelines for Collecting Heights and Weights on Children and Adolescents in School Settings:[120] www.cnr.berkeley.edu/cwh/PDFs/color_weighing.pdf.
- Guidelines for Growth Screening in Missouri Schools:[121] www.dhss.mo.gov/SchoolHealth/GuidelinesForGrowth.pdf.
- Pennsylvania Advocates for Nutrition and Activity Growth Screening Communication Kit for Schools and Communities:[48] panaonline.org/programs/khz/screening.

3. Ensure that the setting for data collection is private.

Height and weight measurements must not be conducted within sight or hearing distance of other students. The trained staff member conducting the measurement should be the only person to see the results and should not announce them out loud.[49] To maintain anonymity when collecting data for surveillance purposes, school staff should remove identifying information, including the student's name, from the data collection form as soon as record keeping is complete and prior to calculating BMI and aggregating and analyzing the data.[122]

4. Use equipment that can accurately and reliably measure height and weight.

The preferred equipment to assess students' weight is an electronic or beam balance scale that is properly calibrated to the nearest one-fourth pound according to the manufacturer's directions.[109] Spring balance scales, such as bathroom scales, are not sufficiently accurate. The preferred equipment to assess height is a stadiometer, a wall-mounted or portable unit solely designed to measure height to the nearest one-eighth inch.[109] The stadiometer should include a vertical board, metric tape, and horizontal headpiece that slides down to measure height. All equipment should be maintained and calibrated regularly.[109]

5. Ensure that BMI is calculated and interpreted correctly.

The formula for calculating BMI is as follows:

$$\frac{\text{Weight (lb)}}{[\text{Height (inches)}]^2} \times 703.$$

Schools should establish the BMI-for-age percentile using the CDC growth charts, available on the CDC's Web site (www.cdc.gov/growthcharts).[123] Staff must collect the student's correct age in years and months as well as their gender to properly plot the BMI on the CDC growth charts. Schools conducting BMI screening programs should refer youth categorized as underweight, overweight, and obese to a medical care provider for diagnosis and possible weight management counseling.[123]

6. Develop efficient data collection procedures.

To facilitate efficient and accurate data collection, BMI measurement programs should coordinate data collection times with school administrators and employ a sufficient number of staff members to minimize disruptions to class time. In Florida, some districts use software that automatically calculates BMI after the necessary variables are entered.[52,102] The software substantially reduces the time it takes staff to conduct screenings. In addition, the software can aggregate the data and produce health report cards.[52,102]

7. Do not use the actual BMI-for-age percentiles of the students as a basis for evaluating student or teacher performance (eg, in physical education or health education class).

Many factors beyond physical education and health education courses influence a student's weight, so it is not appropriate to hold students or teachers accountable for changes in BMI percentiles. Using BMI results to evaluate performance might heighten attention to weight and increase stigmatization and harmful weight-related behaviors. Knowledge, skills, and changes in dietary, physical activity, and sedentary behaviors are more appropriate as performance measures.

8. Evaluate the BMI measurement program by assessing the process, intended outcomes, and unintended consequences of the program.

Data should be collected on concerns about the program, such as stigmatization, cost, parental responses, and displacement of other health-related initiatives. Schools can use the evaluation results to guide improvements to their program. The results should be shared with key stakeholders, parents, the community, school administrators, and policy makers to inform their decisions about school-based BMI measurement. The CDC's Division of Adolescent and School Health Web site provides program evaluation resources:[124] www.cdc.gov/healthyyouth/evaluation/resources.htm.

Additional Safeguards for BMI Screening Programs

1. Ensure that resources are available for safe and effective follow-up.

Because BMI screening programs are not intended to diagnose weight status, schools should refer students who need follow-up to appropriate local

medical care providers. Before initiating a screening program, schools should work with the local medical community to ensure that adequate diagnostic and treatment services are available, staffed by employees with appropriate training, and accessible to all students, including those with low family incomes or without insurance. Schools should also identify school- or community-based health promotion programs that encourage physical activity and healthy eating. School nurses should be educated, trained, and equipped with the appropriate resources to respond to parents requesting guidance.[125] School nurses can be a valuable resource during the follow-up period because they can provide parents with a clear explanation of the results and health risks associated with obesity, develop an action plan for behavior change, and connect the family to medical care in the community.[125]

2. Provide all parents with a clear and respectful explanation of the BMI results and a list of appropriate follow-up actions.

Student BMI results should be sent to parents by secure means, such as by mail, and not brought home by students. To reduce the risk of stigmatizing students, letters should be sent to all parents.[24,117] To avoid giving the impression that a diagnosis has been made, the letters to parents about students who need further evaluation—those classified as underweight, overweight, or obese—should avoid definitive statements about the student's weight category.[22] For example:

1. Letters might state that the student's BMI result ''suggests'' that he/she ''might be'' overweight.[47]
2. Letters might simply identify the student's height, weight, and BMI-for-age percentile and include a table defining BMI-for-age percentile categories.[48]
3. Letters might state that the student's weight was found to be low/normal/high for his/her height and age.[120]

All letters should strongly encourage parents to consult a medical care provider to determine if the student's weight presents a health risk.[35]

Letters to all parents, including those whose children have been classified as normal weight, should include scientifically sound and practical tips designed to promote health-enhancing physical activity and dietary behaviors. For example, the letters might summarize the US Dietary Guidelines for Americans, which recommend that youth include a variety of fruits and vegetables, whole-grain products, and fat-free or low-fat milk in their diet each day.[126] Parents should also be aware that youth should engage in at least 60 minutes of physical activity on most, preferably all, days of the week.[126] The letters should be written in appropriate languages and at appropriate reading levels to be understood by parents; the tone should be neutral to avoid making parents feel that they are being blamed for their child's weight status.[46] Motivational messages included in the letters should be guided by sound communication and health behavior change theories. To ensure comprehension and effectiveness, the letters can be tested with representative parents in advance.

If the safeguards described above are implemented, BMI results may also be shared directly with older students—the Michigan Department of Education recommends that results not be shared with students below grade 4—as long as staff ensure that this communication remains private and does not stigmatize or label the students.[49] Because these letters could have a significant impact on the students, the school nurses and school counselors should be prepared to deal with such reactions as anxiety and despair.

The letters should include (a) contact information for the school nurse or other school-linked medical care provider; (b) educational resources for weight, nutrition, and physical activity; (c) contact information for community-based health programs or medical care providers who treat weight-related problems (including programs for those without health insurance); and (c) information on school- and community-based programs that promote nutrition and physical activity.

Screening programs have developed standardized letters tailored to the weight status of the child.[47,48,119] Examples are available at:
panaonline.org/programs/khz/screening; www.achi.net/BMI_info/health_letter.asp; and www.cnr.berkeley.edu/cwh/PDFs/color_weighing.pdf.

Additional guidance on BMI measurement safeguards is available in:

- Center for Weight and Health at the University of California Berkeley, *Weighing the Risks and Benefits of BMI Reporting in the School Setting*:[21] nature.berkeley.edu/cwh/PDFs/BMI_report_cards.pdf.
- Michigan Department of Education, Michigan Department of Community Health, The Governor's Council on Physical Fitness, Health and Sports, and Michigan Fitness Foundation, *The Role of Michigan Schools in Promoting Healthy Weight*:[49] www.michigan.gov/documents/healthyweight_13649_7.pdf.

RESEARCH NEEDED ON BMI SURVEILLANCE AND SCREENING PROGRAMS IN SCHOOLS

Research is needed to address a number of outstanding issues regarding school-based BMI surveillance and screening programs, including:

- the types of follow-up actions taken by parents and students and the programs' intended and unintended physical, social, and psychological effects

- student perceptions of and attitudes toward height and weight measurement in schools
- the role and capacity of the school or school district nurse to implement and manage the BMI measurement program
- the effects of BMI measurement programs on school-based efforts to promote nutrition and physical activity
- the effectiveness of treatment for youth who are identified as obese or overweight in BMI screening programs
- cost-benefit analyzes of school-based BMI measurement programs compared with alternative strategies
- relative efficiency of using schools as a BMI measurement site
- effectiveness of different methods for communicating BMI results and related risk information to parents and youth
- ability of the school nurse to link parents with medical services offered in the community for referrals.

CONCLUSIONS

School-based BMI measurement programs are being implemented in a number of states and school districts and are under consideration in many other jurisdictions as a possible approach for addressing childhood obesity. To date, there is insufficient evidence to conclude whether school-based BMI measurement programs are effective at preventing or reducing childhood obesity. Before implementing these programs, decision makers need to consider the costs involved, potential negative consequences for students, and the impact on other school efforts to address obesity. A first step in the decision-making process is to determine whether school-based BMI measurement should be used for surveillance or screening purposes, or both.

School-based BMI surveillance programs produce prevalence and trend data on populations of students. The collection of BMI data for surveillance purposes is less controversial than BMI screening programs because surveillance does not involve the communication of sensitive information to parents and does not require individualized follow-up care for students identified to be at risk. However, these programs must still adhere to the safeguards presented in this article to avoid unintended negative consequences.

Concerns have been raised about school-based BMI screening programs potentially harming students by increasing the stigma attached to obesity and increasing pressures to engage in unsafe weight-control behaviors. School-based BMI screening programs do not meet AAP standards for mandated screening efforts because their effectiveness has not yet been established by research, proven treatments for obesity are not yet widely available, and not all communities have resources to help at-risk individuals access treatment services. However, these programs have potential merit and are worthy of further scientific research and evaluation because obesity is highly prevalent and has a significant impact on health; BMI is an acceptable measure of weight status; and schools are a logical measurement site. Furthermore, effectively administered BMI screening might be able to correct misperceptions of weight status, which are widespread among youth and their parents and could contribute to unsafe weight-control behaviors.

Any effort to implement and evaluate school-based BMI screening programs should (a) rigorously adhere to the safeguards identified in this report to minimize the risk to students; (b) take place in schools with a safe and supportive environment for students of all body sizes; and (c) effectively refer at-risk students to accessible medical care services for assessment and guidance, as well as to accessible physical activity, nutrition, and health promotion services. In addition, schools must ensure that their BMI screening programs enhance, rather than detract from, proven strategies to promote youth physical activity and healthy eating in the school setting.

This article provided guidance on the positive and negative characteristics associated with school-based BMI measurement programs. Further research is needed to understand the benefits and consequences of measuring student BMI. A stronger research base could provide states, school districts, and schools with critical information they need to determine whether to implement a school-based BMI measurement program.

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